

# A REGULABLE COMBINED DROPPING AND POURING DEVICE FOR THE ADMINISTRATION OF ANÆSTHETICS.

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LONG ago the dictum has ceased to be a matter of dispute, that all medicinal agents act the most safely for the patient and the most satisfactorily for the physician, when their administration is graduated as accurately as possible in accordance with the susceptibility of the subject and with the desired degree of therapeutic effect.

In the field of anæsthesia, the first agent as to which this fact was established was chloroform. To use the exact words of Sir James Simpson, the original method of administration was to deliver the vapor "*powerfully and speedily*," in order to prevent the excitement incident upon slower procedure. So many deaths were the result of this technique, that by 1860, or about thirteen years after the anæsthetic value of chloroform was first applied to human beings, he recommended the drop-by-drop method of delivery. No one who is worthy of reputation for skill in anæsthetization has ever since that time departed from this mode of using this potent and withal rather dangerous general anæsthetic.

The great advantages of the drop-by-drop exhibition of chloroform are:

(1) *Determination of dose in accordance with susceptibility*; (2) *control of the amount of drug administered from moment to moment*; (3) *accurate variation in this amount at any period of the operation as indicated by the susceptibility, by the character of the operative technique, or by both*; (4) *greater safety of the patient*. The fourth item is inherent in the preceding three factors.

The manifest value of these elements of chloroform anæsthetization suggested application of the drop-by-drop procedure to ether narcosis and to anæsthesias produced by chloroform-ether mixtures or by other general anæsthetics. At the present time, therefore, the wisdom of drop-by-drop employment of general anæsthetics is not questioned, and the desideratum is established for *one* instrument which will combine regulability of dropping and pouring, if need should arise, as often does in the early stages of ætherizations, and which will be available for any other general anæsthetic or mixture of anæsthetics.

A large number of dropping fixtures and dropping bottles have been devised with the purposes of securing controllable drop-by-drop delivery. In the effort to design one which corrects all the disadvantages of the others, the regulable combined dropping and pouring attachment which is the subject of this paper has been produced after much experimentation.

The disadvantages of the metal dropping devices which have been corrected are the following: *First*, practically all others are so attached to their bottles that if the latter be broken a renewal cannot be made excepting, as a rule, through a surgical instrument house, and at rather great loss of time and much expense. The bottle of the author's attachment may be replaced by a common wide-mouth bottle at any drug-shop and in most households instantly and at practically no expense. *Second*, the parts of the droppers now on the market are in themselves usually so small, delicate, and complicated, that they are easily worn, damaged, and put out of order, and then require an instrument-maker for the repairs. The dropper of the author is small enough for neatness of appearance and convenience of packing and management, and sufficiently large to be durable and strong. The conical seating of the plug into the socket takes up the wear as it occurs. It cannot be damaged by any ordinary use or accident. It is extremely simple in construction and may usually be repaired by the owner. *Third*, the bottles of the usual droppers are so small that they are suitable only for chloroform. The four- and six-ounce bottles of the author's device are available for ether, chloroform, and their

mixtures, either of these sizes being furnished with the dropper as desired. *Fourth*, the dropping of the majority of fixtures is rather difficult to regulate, somewhat uncertain in action, and unexpectedly will change to a pouring. In the writer's instrument the dropping is accurately controllable, is with difficulty thrown out of adjustment, and nevertheless will deliver a stream by simply inverting the bottle, or turning the plug as a water faucet, as detailed later. *Fifth*, the corks of most of this type of bottle are specially cut and require skilled hands to replace when they become broken or damaged. Any good cork is all that is needed in the author's arrangement, and the hole may be cut into it with a standard cork-borer, such as is sold with the instrument if desired.

The standard glass chloroform drop-bottle has proved in the hands of the author the best of those now on the market, but its limitations suggested the instrument to be described. *First*, destructibility of the essential parts; *second*, rather high cost, especially in virtue of its fragility; *third*, difficulty of securing a bottle with stopper and neck carefully ground and with the flange of the stopper at a proper distance from the flange of the neck, so as to encourage dropping and discourage pouring. This distance should be about a sixteenth-inch; *fourth*, the particular tendency to pour unexpectedly which results from the fact that chloroform may trickle down both the upper or air and the lower or fluid slots, and thus overload the capillary space between the stopper-flange and the neck-flange. The bottle then inevitably pours.

The manner of obviation of these limitations has been described so far as the first two are concerned; the third is corrected by the adjustable disk on the plug of the writer's dropper as later detailed; and the fourth is corrected by the air-vent tube, whose free end is always above the fluid-level, and therefore makes pouring impossible unless the bottle is deliberately turned over so that the tube is submerged and becomes the exit of the contents, thus pouring, while air enters through the slots.

The parts of the dropper of the author are as follows: The *first* essential is a *socket* (Fig. 1) bearing a *flange*, with a



FIG. 1.—Socket without the cork.



FIG. 2.—Plug, flange, and lock-nut.

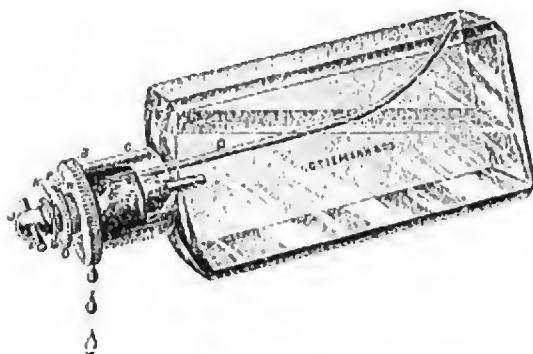


FIG. 3.—Dropper in action.

knurled edge (*B*, Figs. 1, 3), and an *air-vent tube* (*D*, Figs. 1, 3) piercing the flange. The *neck of the socket* has a conical *lumen* (*F*, Fig. 1), in whose wall opposite the air-vent is a groove (*G*, Fig. 1) extending upward two-thirds the length of the socket. On the surface of the flange indicating the axes of the groove and vent is the guide-line (shown in phantom *R*, Fig. 1), whose purpose will presently be shown. The *second* essential is the plug (*I*, Fig. 2). The neck (*K*, Figs. 2 and 3) is threaded for the disk (*N*, Figs. 2, 3) and its lock-nut (*O*, Figs. 2, 3). The disk is of the same dimensions as the flange of the socket. The body of the plug has two grooves (*Q*, Fig. 2) opposite each other, one wide for ether and the other narrow for chloroform. The pinion (*J*, Fig. 2) passes through the head in the axes in these grooves, therefore serving as an indicator of the position of the grooves and as a handle for turning the plug in the socket precisely as a water-faucet. The length of the grooves is such that when the plug and socket are assembled so that their respective grooves are apposed, they overlap each other, and thus form a tortuous channel into the cavity of the bottle, about one-eighth of an inch in diameter, which will deliver a stream large enough for all purposes. If now the plug is turned, its groove, *Q*, slowly moves away from *G*, decreasing the overlap until finally that is a mere capillary channel precisely in the manner of a water-faucet. The power of decreasing or increasing this outlet is the secret of determining the quantity of anæsthetic delivered,—copious, moderate, or small by any desired graduation. The fluid passes through the overlap into the relatively larger capillary space, *Q*, and then reaches the extensive capillary interval between the flange, *B*, and the disk, *N*. This arrangement constitutes a tortuous space always capillary, but largest at the edge of the disk and flange, so that fluid delivered into it through the overlap is compelled to spread out and therefore to drop. The whole success of the device rests upon this fact: a virtually funnel-shaped capillary space receives its fluid at the small overlap and compels it by capillarity to extend itself until the whole space is filled. Dropping then begins as the supply through the overlap

is delivered. The bottle never pours if this supply is correctly determined. The quantity of anæsthetic to be delivered rests upon the adjustment at the overlap. The manner of delivery thereof, namely, in large, slow drops, in large, rapid drops, in small, slow drops, in small, rapid drops, or in any intermediate graduation desired, rests upon the size of the space between disk and flange; the narrower this space is the smaller and more rapid will the drops be. After this detail is determined, the disk is locked by the lock-nut.

The assembling of the device is carried out as follows: The bottle is filled. The socket and cork are placed into the neck. The plug is then inserted into the socket in such a manner that the groove is opposite the guide-line on the flange, which brings the plug-groove and the socket-groove directly over each other. The disk is now run down the neck until it is a thirty-second-inch away from the flange. The capillary spaces are now filled by pouring; then the quantity of anæsthetic desired is determined by turning the plug to the right or left (as a faucet), and finally the size and rate of the drops are fixed by adjusting the disk. These details require a few seconds of time. When the adjustment is made, the bottle will drop by the hour without interruption or variation. At any moment it may be made to pour by turning it over so that the air-vent is submerged, or by turning the plug so that the channel is full-size, that is to say, so that the plug-groove and socket-groove completely correspond. The author has given the dropper the test of a full year's use in many cases of all kinds. In his hands it has never failed to work perfectly.

He desires to extend cordial appreciation and thanks to Messrs. George Tiemann & Co. for many valuable suggestions and kindly interest in producing this satisfactory instrument.